Growing the Mars Community

Action item #6:

Develop a strategy to strengthen/expand the needed talent across the nation (universities, research centers, and industry) in order to implement the vision. In particular, address the instruments and data handling distribution/analysis

Your Action Item #6 Team:
<u>Ride</u>, Arvidson, Kresa, Leshin, Lucid, Mahaffy, McCleese, Viotti

But First…

- **To develop a plan to grow the Mars Exploration Community, we must first understand the goal, so we ask:** ***What size and disciplinary mix of the "Mars Community" is required to conduct the program?***

- **To this end, the group suggests 3 actions for the Mars Program:**

Suggested Actions

1. Characterize the current Mars science community (size, disciplines, age distribution, etc).

2. Quantify the future needs of the Mars science community, both in terms of numbers and in terms of disciplines (e.g., in 5 year increments or by program milestone).

3. Characterize the future need for engineers and scientists, both in terms of numbers and disciplines, to support the human exploration program. How many will be needed, and in what careers, in 2010, 2015, 2020, 2025 to support both lunar and Mars exploration.

This Group Discussed:

- ***Growing the Science Community***
- ***Lessons from EOS***
- ***Growing the Community Required for Human Exploration***

Background: Prior Assessments of Strength of Mars Science Community

- ***In late 2003, a diverse group of scientists representing the Mars community met:***
  - *To discuss whether the community will have the size, composition, and overall health necessary to achieve the Mars program goals; and*
  - *To develop possible strategies to assure that it does.*
- ***The questions included:***
  - *Will we have the required capacity to analyze and interpret the growing scientific diversity, number and volume of martian data sets?*
  - *How can we develop a pipeline of new scientists for the Mars program?*

Conclusions: Factors Limiting the Mars Science Community

- **Current Mars Scientists Struggle**
  - *Financial Uncertainties Plague Individual Scientists*
  - *Early-Career Scientists are Disadvantaged in Attracting NASA Funding*
  - *Mission Data is Difficult to Access and Results of Research are Slow to Appear*

- **Too Few Future Mars Scientists**
  - *Few Opportunities for Involvement in Flight Missions*
  - *Potential Future Scientists Lack of Awareness of Planetary Science as a Career Option*

- **Too Few Inter- and Cross-disciplinary Researchers**
  - *Need Earth scientists, more collaborations in multidisciplinary science*

Current Mars Scientists: Actions

- ***Ease Financial Uncertainties***
  - *Place Greater Emphasis on Funding for Basic Research and Data Analysis.*
- ***Encourage & Support Early Career Scientists***
  - *Strengthen existing graduate programs.*
  - *Form cross-institutional education & training program to teach grad students & faculty how to process and analyze Mars data.*
  - *Encourage involvement of young scientists in missions -- from instrument development through mission planning and data processing*
- ***Improve Access to Data & Results***
  - *Support the reconciling of datasets discrepancies*
  - *Establish uniform standards.*
  - *Develop user-friendly software tools.*
  - *Publish Mars research in an online journal.*

New Faces in the Mars Program

	# of PS	% within 5 yrs of PhD	% women
Mars Pathfinder	19	16 %	5 %
MGS	10	10 %	10 %
Mars Odyssey	11	36 %	9 %
MER	28	7 %	7 %
TOTAL	68	15 %	7 %

PS = Participating Scientists

Future Mars Scientists: Actions

- ***Increase Opportunities for Involvement in Flight Missions***
  - *Student Intern Program for Mars Missions*
- ***Raise Students' Awareness of Planetary Science***
  - *Create element of Mars Education and Public Outreach for future scientists at all levels, from K-16.*
  - *Engage Mars experts in undergraduate lectures around the country.*

Inter- and Cross-disciplinary Researchers: Actions

- ***Convene technical workshops and symposia that bring Mars scientists together with Earth scientists.***

- ***Encourage collaborations by valuing interdisciplinary research in research funding portfolio.***

- ***Support extended visits by Mars scientists to academic departments and NASA Centers.***

Lessons from EOS

Lessons on scaling of data systems for a more intensive Mars exploration (current EOS ~10^{15} bytes/yr, current decade Mars program < 10^{14} bytes)

- Centralized data processing/distribution systems planned far in advance of missions are not likely to be cost effective
- In spite of large differences in data volumes and number of users current directions for both Earth and Planetary Data System show common directions
  - Commercial storage solutions will be sufficient
  - Rapid processing/throughput important for science products (days/weeks)
  - Low volume data products and sub-sampling data mining tools useful
  - Data formats community driven and coupled with analysis/visualization tools with tools to translate between different scientific disciplines
  - Funded PIs responsible for data product generation, but framework/funding available to community for value added products
  - Competitive selection of data systems and service providers
  - Use of open-source development systems when possible
  - Continuously capture users assessment regarding services rendered

Growing Community: Human Exploration

- **Long term issue, important to start now**
- **Can't be done by government alone: requires participation from private sector and educational community**
- **Cross-cutting issue, faced by Lunar Exploration Roadmap**
- **Requires broad range of disciplines (engineering, science, management) and interdisciplinary research and cooperation**
- **Requires growth within academia, government, industry**
- **Requires support and enthusiasm from public**

Growing Community: Human Exploration

- ***Academia: broad range of disciplines (areas of engineering, biology and life sciences, geology and physical sciences).***
  - *Issues are similar to those on "Mars scientific community" charts, but the need is much greater (and must be defined) in terms of:*
    - *Numbers*
    - *Diversity (of disciplines, of population)*

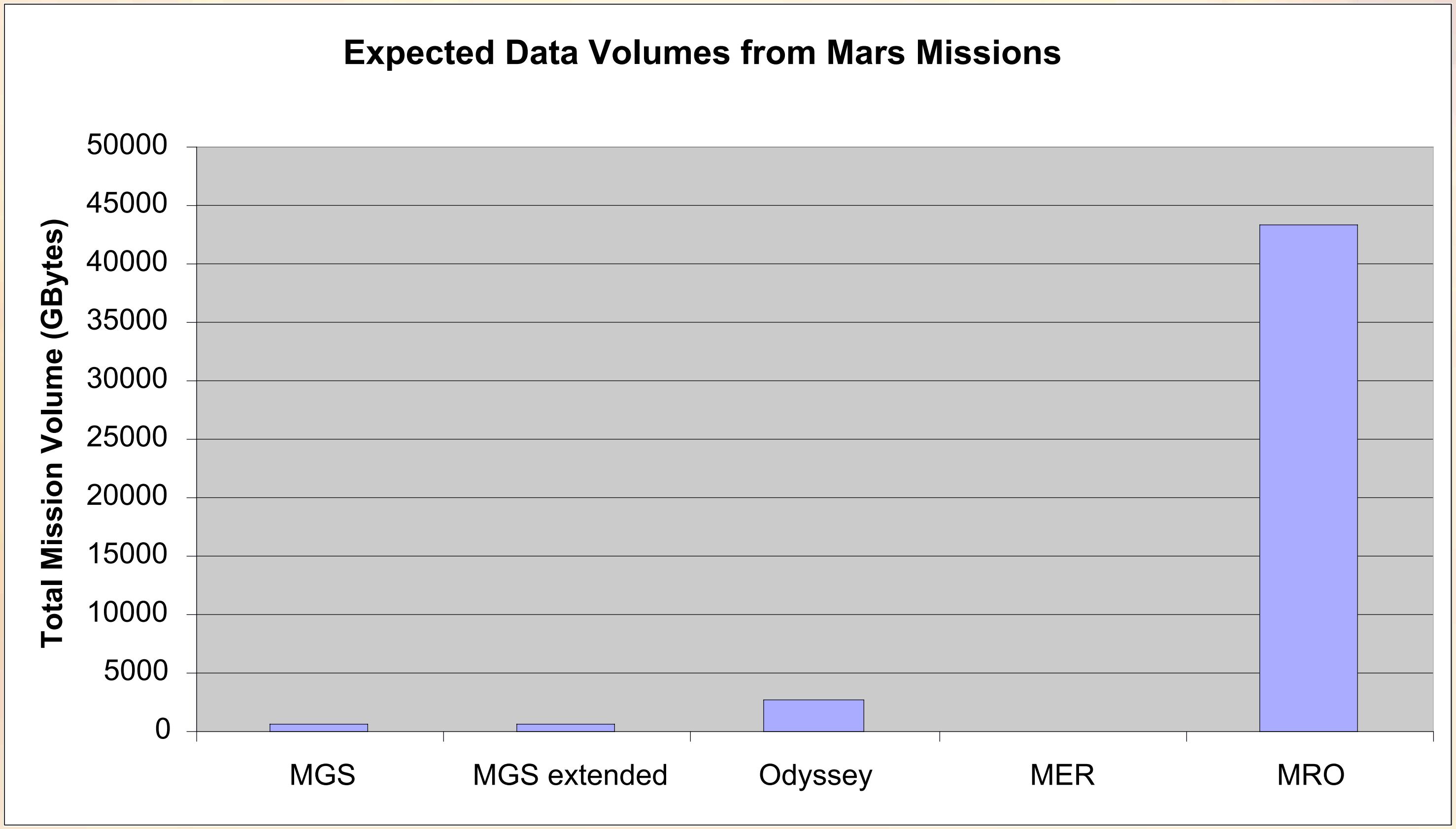
- ***Public: need to start now to educate the public and build support and enthusiasm*** *(excite kids to go into necessary fields, become involved in the program, support its funding)*

- ***Industry: "Show me the money"*** *(capacity will follow funding)*

- ***Government support: Large cuts to NASA Higher Ed budget don't help…***

Back-up slides

Data volume



Expected Data Volumes from Mars Missions
Total Mission Volume (GBytes)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
MGS
MGS extended
Odyssey
MER
MRO

The Mars Program Has Funded Selected Recommendations For FY05 And Beyond

- Flight Intern Program
  - The Flight Intern Program will begin in FY06 with 6-8 interns in the Mars Reconnaissance Orbiter project. Initial funding is $190K/year, growing to $300K/year during operations.
- Technical Workshops
  - An interdisciplinary science workshop is being developed to address either sedimentology or atmospheric chemistry.
- Online Journal
  - UCLA is developing an online Mars journal with startup funds from Mars program.
- Additional Ongoing Programs
  - Funding is provided to graduate and undergraduate students to attend Mars-related conferences and workshops to present their research and meet with colleagues in their field.

Growing the Community Group
(GTC Group)

Name	Affiliation	Employment
Arvidson, Ray	Washington University	University professor
Garvin, James	NASA/HQ	Program science
Gilmore, Martha	Wesleyan University	University professor
Head, Jim	Brown University	University professor
Kieffer, Hugh	USGS (Retired)	Research scientist
Leshin, Laurie	Arizona State University	University professor
McConnochie, Tim	Cornell University	Graduate student
Mischna, Michael	UCLA	Graduate student
Paige, David	UCLA	University professor
Rothschild, Lynn	NASA/ARC	Research scientist
Saunders, Steve	NASA/HQ	Program management
Schaller, Emily	Caltech	Graduate student
Stansbery, Eileen	NASA/JSC	Field Center management
Vasavada, Ashwin	UCLA	University professor

Conveners

Beaty, David	Mars Program Office	Program management
McCleese, Dan	Mars Program Office	Program science
Syvertson, Marguerite	Mars Program Office	Program support

Mars mission current decade data volumes and number of users

Mars Global Surveyor, assuming EOM October 2006 1200 Gbytes
2001 Mars Odyssey, assuming EOM October 2006 4331 Gbytes
Mars Exploration Rovers, assuming EOM January 2006 6400 Gbytes
Mars Reconnaissance Orbiter, primary mission 72000 Gbytes
Phoenix Lander, primary mission 200 Gbytes
(Phoenix official estimate is probably low; likely to be equivalent to 1 MER)

Planetary Data System - Number of current users:

December 2004, 538,727 unique IP addresses -- presumably unique users -- accessed PDS web sites (typical month).

Metrics for December also showed 86,472,088 files downloaded, 35,013,444 Mbytes of data downloaded, and 933 CDs and 101 DVDs distributed.

EOS DAAC

In FY2004, 2,085,597 distinct users accessed the DAACs (just for general information)

" 202,815 distinct users obtaining data from DAACs

" we had a daily distribution volume of 1.86 TB

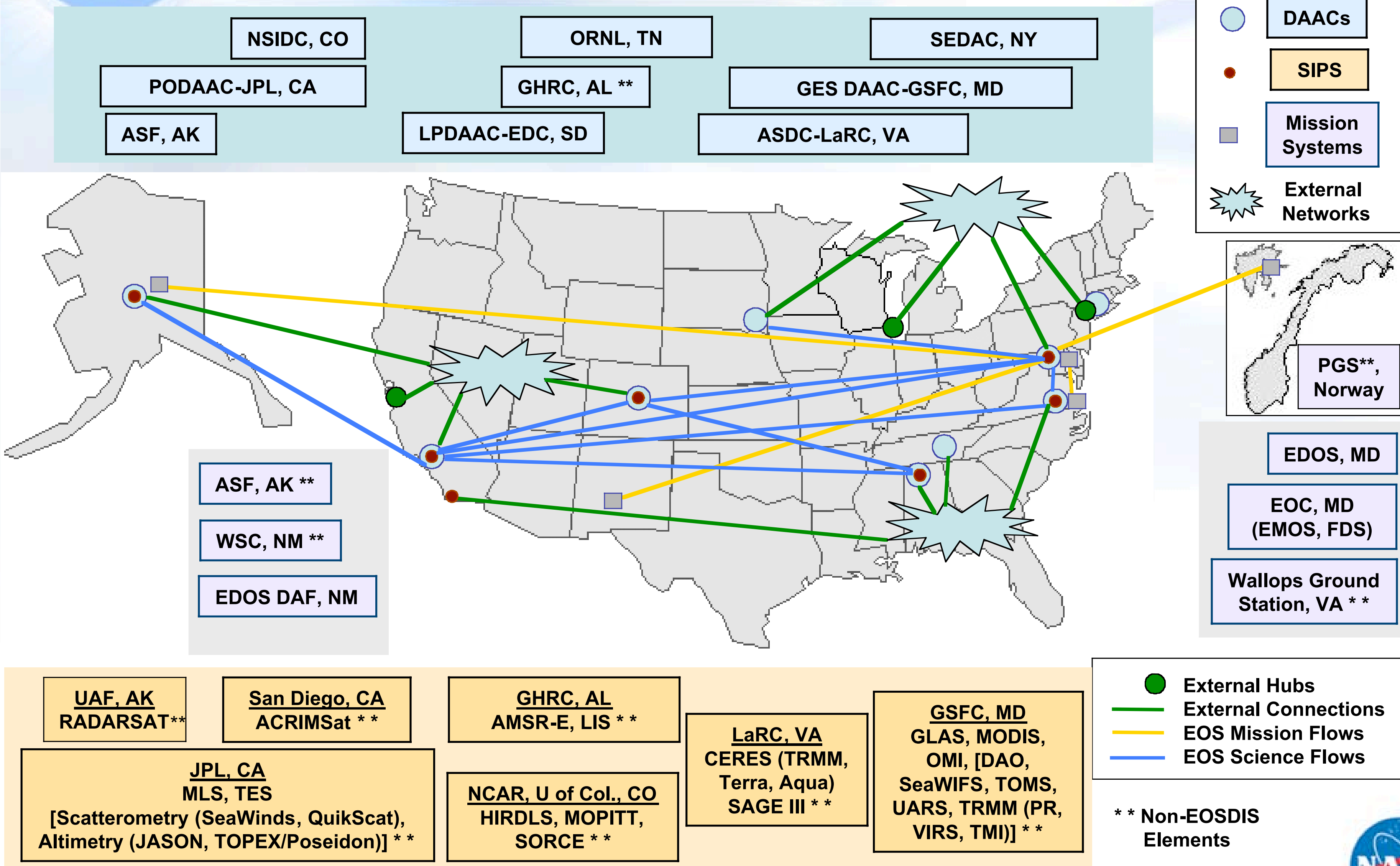
" we distributed 34.1M products

" the archives grew at a rate of 4.2 TB a day

Overview of Current EOSDIS

Jeanne Behnke
(301) 614-5285
Jeanne.Behnke@nasa.gov

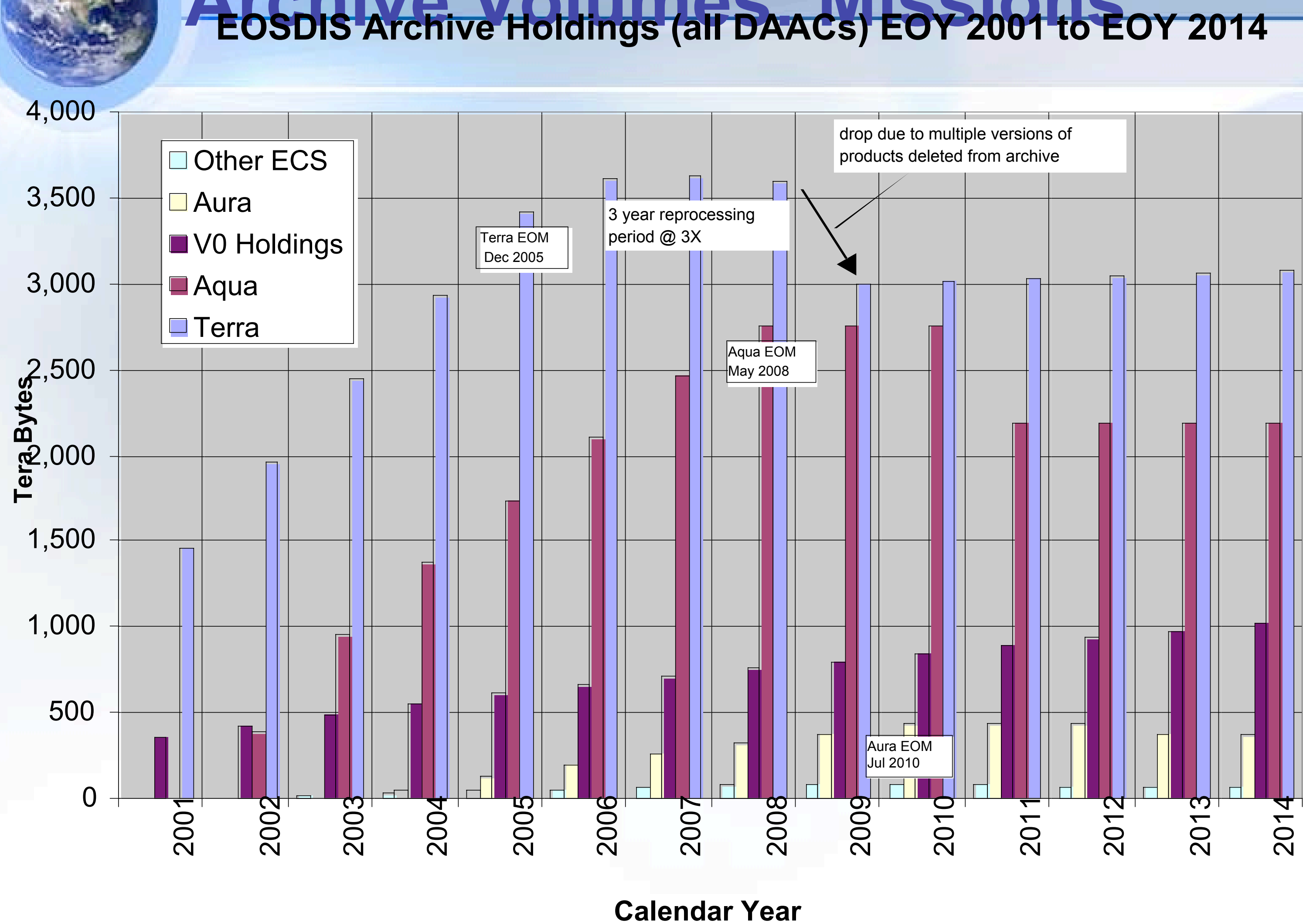
Geographic Distribution of EOSDIS DAACs, SIPS, and Interfacing ESE Elements



* * Non-EOSDIS Elements

File Name: Map_EOSDIS_Sites_11222004

Archive Volumes: Missions



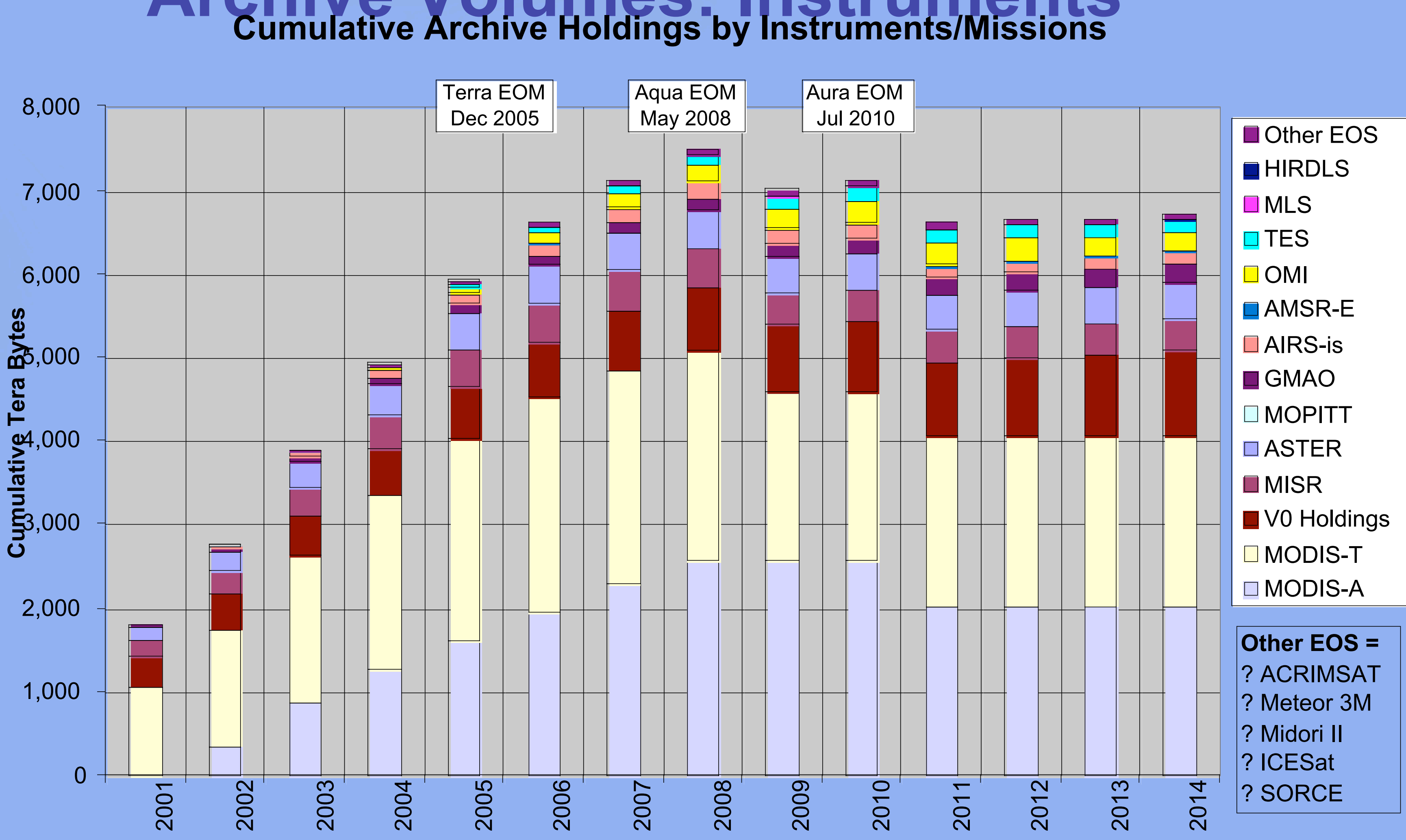
Other ECS:
- ? ACRIMSAT
- ? Meteor 3M
- ? Midori II
- ? ICESat
- ? SORCE

V0 Holdings:
- ? ERBS
- ? UARS
- ? TOPEX
- ? ERS 2
- ? Radarsat 1
- ? Earth Probe
- ? OrbView 2
- ? TRMM
- ? Terra CERES
- ? QuikScat
- ? Jason 1
- ? Aqua CERES

file name: archive holdings_122204.xls
tab: ECS + V0 holdings (2)

NOTE: Data remains in the archive pending transition to LTA

Archive Volumes: Instruments



file name: archive holdings_121504.xls
tab: all instr bar

NOTE: Data remains in the archive pending transition to LTA

Lessons from EOS on scaling of data systems for a more intensive Mars exploration

Balance Processing and Distribution Capacity:

o Ratio of produced to distributed data volume should be at least 10 to 1.

o Processing and throughput capacity should support mission reprocessing in matter of days or weeks.

o Any prioritization down selection of products due to capacity limits should be program / PI driven.

o Low volume version of products available (i.e., gridded products)

o Subsetting, subsampling, data mining tools available for users to access the specific data they need.

o Data products should be electronically available (media distribution should be discouraged)

Community Driven Data Format:

o Format selection reflects community practices (not one size fits all)

o Formats closely coupled with analysis and visualization tools

o Community is driver / provider of data format enhancements and tool evolution

o Tools available to translate data between preferred formats used by related science disciplines

Lessons from EOS on scaling of data systems for a more intensive Mars exploration

Adaptive Data Product Suite for Science Programs:

o Funded product suite managed under direction of science program.

o Funded science PI's have responsibility for production / validation / distribution of core product suite.

o Processing framework and science algorithms made freely available to community.

o Initial smaller set to focus on sensor calibration and core science product validation.

o Provide funding opportunities and distribution capacity for value-added products and services.

Data systems effectiveness:

o Avoid large-scale long lead time data systems development.

o Support small-scale multiple adaptive processing, storage, and data access frameworks.

o Invest in open-source system development wherever possible (not proprietary systems).

o Data systems & service providers should be competitively selected / renewed:

o Routine data acquisition / processing / archive / distribution should be highly automated

o Must be able to capture users assessment, intended use, and ideas regarding products & services received